

PUBLIC HEALTH ASSESSMENT

ARMOUR ROAD SITE
NORTH KANSAS CITY, CLAY COUNTY, MISSOURI
[CERCLIS NO. MOD046750253](#)

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Prepared by:

Missouri Department of Health
Section for Environmental Public Health
under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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PUBLIC HEALTH ASSESSMENT

ARMOUR ROAD SITE

NORTH KANSAS CITY, CLAY COUNTY, MISSOURI

SUMMARY

The Armour Road site is the location of a former herbicide blending facility that operated from approximately 1948 to 1986. It is located at 2251 Armour Road in North Kansas City, Clay County, Missouri, in a mostly industrial and commercial area. During its time of operation, the facility used various chemicals including arsenic, 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), pentachlorophenol (PCP), and sodium chlorate to produce herbicides used by the railroad for right-of-way weed control. Because of past activities and disposal practices, the on-site soil, building, and on-site and off-site groundwater have been contaminated, especially with arsenic. The site is restricted with a chain-link fence, but there is evidence that trespass is occurring to an unknown extent. In addition, a polypropylene geo-fabric and gravel cover placed over the contaminated on-site soil has been compromised to some extent. [Exposure](#) pathways at the site consist of [inhalation](#) of, [ingestion](#) of, and [dermal](#) contact with contaminated soil for the on-site trespasser, and the possibility of inhalation of contaminated dust off-site. If access could be eliminated and the polypropylene and the gravel cover properly maintained, current on-site and off-site exposure pathways could be eliminated. Presently, contaminated groundwater is not being utilized for potable water, but a number of industries and the city of North Kansas City (upgradient and side-gradient) use the aquifer for a water source.

Community public health concerns have not been found to be present at the site. The Missouri Department of Health held a public availability session on July 16, 1998 to determine if community health concerns exist.

Considering the exposure pathways and the high levels of contamination (especially arsenic), the site has been given the classification of [Urgent Public Health Hazard](#). Exposure to arsenic at the levels on the site present an additional [risk](#) of cancer. Usage of the arsenic contaminated groundwater as potable water would also present an additional risk of cancer. We recommend that security of the site be improved and that the cover over the site be maintained to eliminate exposure. Access to the contaminated groundwater should also be prevented and remediation of the groundwater and the site be performed to eliminate any possible future exposure.

PURPOSE AND HEALTH ISSUES

The Missouri Department of Health (DOH) is writing this public health assessment to address current, past, and future possible exposure to high levels of environmental contamination (primarily in soil and groundwater) at this site. This document will address past worker exposure, current public and trespasser exposures, and future exposures.

BACKGROUND

The Armour Road site is a former herbicide blending facility located at 2251 Armour Road, in North Kansas City, Missouri. The site consists of approximately 1.8 acres on the south side of Armour Road. There is one on-site 25,000 square foot building adjacent to Armour Road. The area in front and to the east of the building

is covered with concrete, while the rest of the area has a gravel cover. In addition, a chain link fence surrounds the site (1).

The surrounding area is commercial to the north and west with predominately industrial areas, transportation terminals, manufacturing facilities, and heavy industry farther to the west. A residential area and hospital are upgradient and farther to the north, with the nearest residence approximately 700 feet north of the site. Immediately south of the site is a large railroad yard with industrial areas, transportation terminals, manufacturing facilities, and heavy industries farther south to the Missouri River. At the nearest point, the Missouri River is 0.75 mile to the southeast (1). See [Figure 1](#).

From historical records dating back to 1948, the Armour Road facility has been operated by three companies until operations ceased in 1986. Herbicides generated by the facility were used to control weed growth along railroad right-of-ways. Railroad tracks from the adjoining railroad lines still lead into the building where railroad cars were brought inside for maintenance, repair, and loading/unloading. Chemicals used in the herbicide blending process included: arsenic, 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), pentachlorophenol (PCP), and sodium chlorate. Most of the equipment in the building was removed with the exception of two below-ground mixing vats and a below-ground trench used for servicing and unloading railroad cars ([Figure 2](#)). The building reportedly has been closed and locked since operations ceased in 1986 (1). According to interviews with former employees, the business only had approximately five employees (2).

Extensive soil sampling has been conducted on-site and in the immediate area. Contamination of soil extends from the surface to the watertable (approximately 13 to 18 feet deep) and over much of the site. The most significant [contaminants](#) are arsenic, 2,4-D, PCP, and antimony with arsenic being the most widespread. The site seems to have several "hot spots" of arsenic contamination with the maximum discovered in surface soil (0-6 inches). Arsenic was found at 121,000 parts per million (ppm) near the southern end of the building in a 1996 sampling event. Levels in other areas were much lower and varied from 3.8 ppm to 27,000 ppm. Arsenic [concentrations](#) decreased with depth, with a maximum subsurface level of 6,800 ppm at the 15 foot depth. Other soil contaminants found above the Agency for Toxic Substances and Disease Registry's (ATSDR's) Environmental Media Evaluation Guide (EMEG) or the Missouri Department of Health's (DOH's) Any-Use Soil Levels (ASLs) at their maximum level included: antimony (9,650 ppm), lead (16,500 ppm), mercury (156 ppm), thallium (1,360 ppm), benzo(a)pyrene (24 ppm), cadmium (2,200 ppm), 2,4-dichlorophenol (258 ppm), and PCP (250 ppm), (See [Table 1](#)) (1,3).

Contamination found in the building's concrete, floor tiles, and other building materials consisted of arsenic ranging from zero to 6,000 ppm, 2,4-D from zero to 1,500 ppm, and 2,4,5-T from zero to 120 ppm (1). The building has also become inhabited by pigeons, and reportedly the floor is layered with droppings.

Groundwater in the area is used for municipal and industrial purposes. North Kansas City is served by a municipal public water system supplied by wells located 1.3 miles west of the site. These wells are located in the Missouri River alluvial aquifer and side-gradient/upgradient of the contaminated groundwater. Other wells in the area consist of industrial wells that are located side-gradient/upgradient of the site, with the exception of a contaminated off-site industrial well that was used for non-contact cooling. This well was closed in June 1995 after arsenic contamination was discovered. According to an extensive groundwater model developed by the United States Geological Survey in 1997, contaminated groundwater from the site is not expected to affect the wells west of the site, including the two largest pumping wells (North Kansas City Water Supply and National Starch & Chemical Co.) (1).

Groundwater contaminants are similar to those found in the soil (a complete list can be seen in [Table 2](#)). Soils at the site consist of silty clay with imbedded clay and sand lenses in the top 17 to 22 feet (4). The major groundwater contaminants found in shallow monitoring wells (between 15 to 20 feet deep) in this top layer of soil include arsenic and PCP. Different sampling events have shown varying levels of groundwater contamination. In a 1994 sampling, arsenic ranged from non-detectable to 2,060 ppm and PCP ranged from non-detectable to 8,062 ppm (5). In a 1995 sampling, arsenic ranged from 21.6 ppm to 1,669 ppm and PCP

ranged from non-detect to 93.4 ppm. The highest concentration was found around the center of the site (1).

Beneath the silty clay soil is a fine to medium-grained sand that is expected to extend from approximately 22 feet to bedrock. Bedrock is thought to occur at a depth of approximately 60 to 85 feet below the site; however, this has not been confirmed. The depth to bedrock in the area surrounding the site averages 85 to 90 feet, but may be greater than 140 feet (1). Monitoring wells placed in the deeper sands (approximately 35 feet deep) found arsenic concentrations in groundwater ranging from 11 to 362 ppm. PCP ranged from non-detectable to 93.9 ppm (1).

Groundwater contamination has also been found off site (1). Groundwater is known to flow to the south and east toward the Missouri River. The industrial well (mentioned on previous page) downgradient of the site was found to have 1.67 ppm of arsenic in a March 1995 sampling. Previous samplings had shown 0.045, 0.428, and 2.16 ppm of arsenic. This well, located 0.25 miles downgradient from the site, was used in the past for non-contact cooling, but usage was discontinued in June 1995. The only other wells downgradient are seven monitoring wells (0.65 miles southeast of the site) in the North Kansas City Sludge Landfill that is adjacent to the Missouri River. The wells are used only for environmental monitoring. All seven wells had arsenic concentrations in August and November 1996 sampling events, with levels ranging from 0.050 to 0.171 ppm (1).

On May 22-24, 1996, the Environmental Protection Agency (EPA) performed a Time Critical Removal Action to reduce the exposure [hazards](#) at the site. On the south and west of the building, contaminated soil with over 200 ppm arsenic was covered with polypropylene geo-fabric and crushed rock. The rest of the site is covered with concrete or the building. Also, a temporary six-foot chain-length security fence was placed at the southern and eastern borders of the site to complete the fence around the site (1).

On July 26, 1996, a site visit was conducted by DOH and Missouri Department of Natural Resources (MDNR) personnel to observe the site conditions and determine if exposure was occurring since the Time Critical Removal Action. No sign of trespass was observed. The cover over the contaminated soil was in good, but deteriorating condition. It was able to prevent direct exposure to contaminated soil as well as inhalation exposure from possible dust being generated from the site. A problem was noted during the site visit in that access could be gained through an incomplete fence connection in the northwest corner of the site. This is located next to some demonstration playground sets on the adjoining hardware store property. The MDNR staff person agreed to pass this information on and have it corrected. The downgradient contaminated off-site well, one quarter mile from the site, was also observed and found to be disconnected and not-in-use.

On October 21, 1997, DOH and MDNR personnel again visited the site and were given a site tour, a site history, and were updated on what activities have occurred at the site. Other personnel from United States Geological Survey and an environmental consultant for the neighboring property were also present. The previous problem with the northwest corner of the chain-link fence had been corrected and the off-site contaminated well was reported to still be disconnected. The chain-link fence around the site was still in place, but the main gate was unlocked. Also, the fence had been separated in one spot. Evidence (scratch marks on the gravel surface and footprints) was present indicating that someone may have used the gap for an entrance into the site. Deterioration of the polypropylene geo-fabric and gravel cover had occurred, allowing the contaminated soil to become exposed, especially in the drainage ditch on site. Groups of pigeons were also seen entering and leaving the building. The MDNR remedial project manager said that the lack of security would be passed on to the enforcement division to be corrected.

The 1990 population of North Kansas City is 4,130 with 95.3 % of the residents being white, 1.7 % black, and 3 % of other races. Children six years old and younger account for 6.7 % of the population and those 65 years and older account for 23.7 % of population. In 1989, approximately 12 % of the residents were considered to be below the poverty level (6). An estimated 3,798 persons live within one mile from the site (3).

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DISCUSSION

Soil

The Armour Road site soil is contaminated with several contaminants at levels significantly above the Agency for Toxic Substances and Disease Registry's (ATSDR's) Environmental Media Evaluation Guides (EMEG) and/or the Missouri Department of Health's (DOH's) Any-Use Soil Levels (ASLs) (see [Table 1](#)). EMEGs are guidelines used to determine if there is a need to further investigate exposure to these chemicals for their possible health effects. Levels below the EMEG are unlikely to pose a health threat. An ASL is a health-based value that represents the maximum concentration of a chemical that will always be acceptable in the soil, regardless of future land use.

In the past, workers were probably exposed to site contaminants through direct contact with the chemicals, possibly through direct contact with the chemicals in soil, and possibly through inhalation or incidental ingestion of contaminated soil particles.

Although the site has a security fence surrounding it, there is evidence of trespassing on the site. During the most recent DOH site visit, there was a gap in the fence and the gate was unlocked. The contaminated on-site soil has become exposed in some areas through movement of the gravel cap and deterioration of the polypropylene geo-fabric. The exposed soil is mostly unvegetated. Therefore, people can gain access to the site and become exposed to contaminated soil through direct contact with, and/or inhalation or ingestion of soil particles. There is evidence that people are using the site, although the type and duration of use is unknown.

To determine possible health effects, a trespasser exposure scenario was considered. The scenario included a teenager (weighing 43 kilograms) visits the site two days per week during the warmest three months of the year for five years. The scenario assumed the teenager to ingest, conservatively, 100 milligrams of soil per day. This resulted in an acute dose of .28 milligrams of arsenic per kilogram of body weight per day (mg/kg/day), and an intermediate dose of .019 mg/kg/day, both of which are above the ATSDR Minimal Risk Level (MRL) of 0.0003 mg/kg/day, based on a chronic exposure. No MRL is available for acute or intermediate exposure. An MRL is an estimate of daily exposure of a human being to a chemical that is likely to be without an appreciable risk of deleterious effects (noncarcinogenic) over a specified duration of exposure. MRLs are based on human and animal studies. Based on these numbers, this scenario could result in adverse effects to the following human body systems: gastrointestinal, dermal/ocular, neurological, and possibly the cardiovascular, hematological, and hepatic systems. The toxicity of arsenic is discussed further below.

To evaluate the risk of cancer, the ingested dose was averaged over a 70 year life time. Using EPA's oral slope factor, there is a slight increase in the lifetime risk of developing cancer ([Appendix C](#)).

There is also a slight potential for off-site migration of contaminated dust from the soil. Using an exposure scenario assuming an adult worker (weigh 70 kilograms) drives past the site en-route to work five days per week, 50 weeks per year for 30 years results in an inhaled dose less than the MRL. There is no expected adverse health effects from this exposure pathway.

Reportedly, the on-site building floor is layered with pigeon droppings. If there are droppings in the building, they represent another possible health hazard to people entering the site. Through inhalation of aerosolized agents people could become ill with histoplasmosis or psittacosis.

Future potential exposure pathways would continue to include dermal contact and inhalation or ingestion of soil particles by trespassers and possible off-site migration of contaminated dust, unless the site is made secure and the polypropylene geo-fabric and gravel cover are repaired. As long as the polypropylene geo-fabric, its gravel cover and the security fence are maintained, exposure to on-site contaminated soil and dust would not be expected.

Future exposure receptors include remedial workers who could be exposed to contaminants from the building and soil due to direct contact with the substances, and/or inhalation and incidental ingestion of dust/soil.

Groundwater

Contaminants from the soil are entering the groundwater at this site. Arsenic, along with other site contaminants, has been found in the groundwater at concentrations above ATSDR EMEGs and the Environmental Protection Agency's (EPA's) Maximum Contaminant Level (MCL) (see [Table 2](#)). An MCL is the maximum permissible level of a contaminant in water which is delivered to any user of a public water system. DOH considers concentrations above the MCL to be of health concern.

The only wells downgradient of the site that are currently in use are monitoring wells. Therefore, no current exposure to contaminants from groundwater should be occurring. Future exposure to groundwater could occur to remedial workers, primarily through dermal contact and incidental ingestion. In addition, any drinking water wells installed within the contaminated plume would lead to exposure through ingestion and dermal contact. Also, industrial wells installed within the contaminated plume could lead to dermal exposure. Assuming an adult would ingest two liters of water per day over a lifetime, and using the highest arsenic concentration from on-site groundwater as an upper-bound estimate of exposure concentration, an ingested dose of 58.9 mg/kg/day is determined. This is clearly above the MRL for arsenic and is of concern for health effects.

Arsenic toxicity

Although this site is contaminated with a variety of chemicals at concentrations significantly above levels of health concern, arsenic is the chemical of primary concern due to its extremely high levels in soil and groundwater.

Long-term oral exposure to inorganic arsenic can cause a pattern of skin changes including darkening of the skin, and the appearance of small "corns" or "warts" on the palms, soles, and torso. Although these changes are not considered to be a health concern, a small number of the corns may ultimately develop into skin cancer. The Environmental Protection Agency (EPA) has classified arsenic as a Class A or known human carcinogen. Other possible health effects from ingesting inorganic arsenic include a decreased production of red and white blood cells, abnormal heart rhythm, blood-vessel damage, and impaired nerve function causing a "pins and needles" sensation in the hands and feet. Inhalation of high levels of inorganic arsenic can result in a sore throat, irritated lungs, skin effects mentioned above, and an increased risk of lung cancer. Dermal contact with inorganic arsenic may cause some redness and swelling of the skin ([8](#)).

CHILDREN'S HEALTH SECTION

Although it isn't likely that young children would be trespassing on this site, if they were to gain access and become exposed, the health effects mentioned above could be more severe. Due to children's smaller body weight, the amount of exposure per unit body weight would be greater than seen in teenagers and adults, thus

resulting in a greater exposure.

COMMUNITY HEALTH CONCERNS

There are no known public health concerns about the Armour Road site. As part of the Armour Road Public Health Assessment's release (Public Comment version), DOH/ATSDR held a public availability session on July 16, 1998, to gather more information on community health concerns. Three community members attended the session; however, none of them had public health concerns.

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CONCLUSIONS

Because contaminants are present at levels of significant health concern, and because some exposure appears to be occurring, the Armour Road site has been classified as a Urgent Public Health Hazard. This classification is based on the following conclusions.

1. Soil and groundwater are contaminated with a variety of chemicals at levels of health concern. The contaminant of principle concern is arsenic.
2. Site access is supposed to be restricted with chain-link fence, but there is evidence of trespassers being on the site. The geo-cover and gravel cover is not completely intact. Contaminated soil poses a threat to trespassers entering the site; therefore, this site currently presents an urgent public health threat.
3. There are no private drinking wells or public water supply wells down-gradient of the site so there is no ongoing threat posed by groundwater at the site.
4. Future potential exposure pathways include the current trespasser scenario and off-site migration of contaminated dust. In addition, remedial workers could be exposed to site contaminants, and any drinking water wells installed within the contaminated plume could lead to exposure through ingestion or dermal contact. Even if the gravel cover, polypropylene geo-fabric, and security fence are repaired, there still exists a potential for them to be compromised. This would result in exposure to contaminants at levels of health concerns.
5. In the past, exposure to contaminants probably occurred to on-site workers through direct contact with the chemicals, possibly through direct contact with the soil, and possibly through inhalation or incidental ingestion of contaminated soil particles.

RECOMMENDATIONS

1. Improve and maintain site security to prevent access and exposure to on-site contaminants.
2. Repair the degraded sections of the polypropylene geo-fabric and gravel cover so that all contaminated soil is capped.
3. Since the potential exists for future exposure to groundwater, measures should be taken to eliminate further groundwater contamination.
4. Prevent access to contaminated groundwater to prevent exposure until groundwater can be remediated.
5. Ensure that remediation workers use the appropriate protection equipment and follow standard health protective procedures when working with contaminated materials.

When additional information becomes available, it will be thoroughly evaluated, and existing assessment documents will be updated to reflect any changes. DOH/ATSDR will respond appropriately to any request

for additional information or action.

PUBLIC HEALTH ACTION PLAN

The Public Health Action Plan (PHAP) for the Armour Road site contains a description of actions to be taken by DOH and ATSDR. The purpose of the PHAP is to ensure that this public health assessment not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present, and/or future exposures to hazardous substances at or near the site. Included is a commitment from DOH and/or ATSDR to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by DOH and/or ATSDR are as follows:

1. DOH/ATSDR will coordinate with the appropriate environmental agencies to implement the recommendations in this public health assessment.
2. DOH/ATSDR will provide follow-up to this PHAP as necessary. This follow-up report will be placed in the repositories that contain this public health assessment.
3. DOH/ATSDR will evaluate any further data that become available about human exposure or contaminants at the site.

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CERTIFICATION

The Armour Road Public Health Assessment was prepared by the Missouri Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

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The Superfund Site Assessment Branch of the Division of Health Assessment and Consultation, ATSDR, has reviewed this Health Assessment and concurs with its findings.

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APPENDIX A

[Figure 1: Armour Road Site Location Map](#)

[Figure 2: Armour Road Site Map](#)



[Figure 1. Armour Road Site Location Map](#)



[Figure 2. Armour Road Site Map](#)

APPENDIX B

[Table 1: Armour Road Site Maximum Soil Contamination Levels and Health Comparison Values](#)

[Table 2: Armour Road Site Maximum Groundwater Contamination Levels and Health Comparison Values](#)

Table 1

Armour Road Site Maximum Soil Contamination Levels and Health Comparison Values

All values in parts per million (ppm)

Contaminant	Maximum Detected Value	ATSDR Comparison Value*	DOH ASL Value**
Arsenic	121,000	20	11
Antimony	9,650	20	23
Lead	16,500	N/A	240

Mercury	156	N/A	17
Thallium	1,360	N/A	3.9
Benzo(a)pyrene	24	0.1	0.68
Cadmium	2,220	40	28
2,4-Dichlorophenol	258.5	200	170
PCP	250	50	42

N/A = not available

* EMEG or RMEG for child (EMEG = Environmental Media Evaluation Guide (ATSDR))
(RMEG = Reference Dose Media Evaluation Guide)

** Missouri Department of Health Any-Use Soil Level

Table 2

**Armour Road Site Maximum Groundwater Contamination Levels
and Health Comparison Values**

All values in parts per million (ppm)

Contaminant	Maximum Detected Value	ATSDR Comparison Value*	EPA MCL**
Arsenic	2,060	0.003	0.05
PCP	8,062	0.01	0.001
2,4-D	94	0.1	0.07
2,4,5-T	320	0.1	N/A
Cadmium	1	0.007	0.005
Lead	5.8	N/A	0.015***
Mercury	0.033	0.02a	0.002a
Thallium	3.5	0.0004	0.002
2,4-Dimethylphenol	27.566	0.2	N/A
2,4-Dichlorophenol	7.168	0.03	N/A
Phenol	27.32	6	N/A
2,4,5-Trichlorophenol	5.21	1	N/A
2,4,6-Trichlorophenol	4.52	0.4	N/A
Selenium	0.48	0.02	0.05
Antimony	6.1	0.004	0.006

N/A = not available

*EMEG or RMEG for child (EMEG = Environmental Media Evaluation Guide (ATSDR)) (RMEG = Reference Dose Media Evaluation Guide)

** EPA MCL = Environmental Protection Agency's Maximum Contaminant Level

*** EPA Action Level

^a = Inorganic mercury

APPENDIX C

Calculations for Cancer Risk

Narrative explanation:

Averaging the ingested dose over a 70 year lifetime, then taking that value by the EPA oral slope factor results in a carcinogenic risk of .00195 (1.95×10^{-3}). EPA and DOH consider any increased lifetime risk of developing cancer which is greater than 1×10^{-4} to 1×10^{-6} to be unacceptable. A cancer risk of 1×10^{-4} and 1×10^{-6} indicates that an additional 1 in 10,000 and 1 in 1,000,000 persons would be expected to get cancer above the normal expected cancer rate. The calculated cancer rate of 1.95×10^{-3} would add an additional cancer incidence of 1.95 people in every 1,000 people. These incidences of cancer would be in addition to the approximately 40% of the population who will develop cancer in their lifetime.

Exposure Factor Calculation:

$$\frac{2 \text{ days/week} \times 12 \text{ weeks/year} \times 5 \text{ years}}{365 \text{ days/year} \times 70 \text{ years}} = 0.0047$$

Dose Calculation

$$\text{Dose} = \frac{\text{concentration} \times \text{amount ingested} \times \text{exposure factor} \times 10^{-6} \text{ conversion factor}}{\text{Body weight}}$$

Assumptions:

Concentration of Arsenic in soil-121,000 mg/kg

Amount of soil ingested per day-100 mg/d

body weight-43 kg

$$\frac{121,000 \text{ mg/kg} \times 100 \text{ mg/d} \times 0.0047 \times 10^{-6} \text{ mg/kg}}{43 \text{ kg}} = 0.0013 \text{ mg/kg/d}$$

$$\text{Risk calculation} = \frac{\text{calculated dose}}{\text{EPA slope factor}}$$

$$\frac{0.0013 \text{ mg/kg/d}}{1.5 \text{ mg/kg/d}} = 0.00195 \text{ or } 1.95 \times 10^{-3} \text{ risk}$$

Figure 1

Armour Road Site Location Map



SOURCE: USGS Topographic Map
7 1/2 min. Quadrangle Map, 1975
North Kansas City, MO. - Kansas

Figure 2

Armour Road Site Map

ENVIRONMENTAL CANADA

